5.0 REVIEW OF PHOTOGRAPHIC DATA

The photographs taken by the photo enforcement cameras systems are a most valuable source of information for the evaluation of the operation of the camera system. Unfortunately, photographs of violations where citations are not issued are not saved. Consequently, it was not possible to review photographs and related data for discarded violations for the evaluation. Aggregate data documenting the reasons why citations were not issued for certain photographs was available and have been analyzed for all intersections. In addition, the photographs and related data for citations issued were reviewed for a random sample of citations issued.

The data analyzed contains all red light violations made at all photo-enforced intersections throughout the entire enforcement period. Each individual violation candidate was either cited or not. If a photographed violation was not cited, it was classified with a label that identified the reason for not being cited. By analyzing the violation data for each intersection, it is possible to quantify the performance of the intersection-based camera equipment for each individual intersection.

5.1 VIOLATIONS DATA BASE

The violations data base is a complete data set that contains data for all photographed or potential violations. The term “potential violation” is used because a number of them were subsequently determined not to be violations. The enforcement starting dates of 19 photo-enforced intersections differed from location to location, and the data collection periods for each intersection therefore vary accordingly. The longest data collection period is 32 months while the shortest period is 14 months.

The cases that are classified as “No Violation” are those that failed to satisfy, at least one of preset violation criteria. The majority of those classified under this category were motorists who entered the intersection within the grace period used by the Police Department. “Total Violations” represents the total number of photographed violations that met the violation criteria. The number of “Total Violations” is then further classified again into three groups: Citations Issued, Citations Not Issued For Uncontrollable Factors, and Citations Not Issued For Controllable Factors. The violations data shows a total of 273,471 potential violations for the entire enforcement period; 233,308 of which were classified as violations and counted under “Total Violations”; and 83,931 violations where motorists were cited. This means that citations were issued for only 36 percent of all violations and that over 60 percent of the photographed violations were discarded for a variety of reasons.

Table 5-1 and Figure 5-1 show the detailed breakdown of the possible violations for the entire enforcement period. It should be noted that the reasons assigned for rejecting violations are the result of subjective evaluations of different LM/ACS processing staff.

Table 5-1
DISPOSITION OF PHOTOGRAPHED VIOLATIONS FROM SEPTEMBER 1998 THROUGH JUNE 2001

Disposition Category	Number	Percent
TOTAL VIOLATIONS	233,308	100.0
CITATIONS ISSUED FOR NON-CONTROLLABLE FACTORS		
No Front Plate	38,139	16.3
Out of State Plate	2,710	0.1
Glare on Plate	24	-
Illegible Plate	869	-
Plate Obstructed	6,323	2.7
Windshield Glare	3,972	1.7
Driver Obstructed	16,597	7.1
Car Obstructed	8,019	3.4
Emergency Vehicle	2,018	0.8
Expired USPT	202	-
Police Return	2,598	1.1
No DMV Match Found	3,521	1.5
Other	2,185	0.9
No Violation Occurred	39,203	16.8
Total Not Issued For Non-Controllable Factors	87,177	
CITATIONS NOT ISSUED FOR CONTROLLABLE FACTORS		
Framing of Plate	4,230	1.8
Clarity of Plate	1,726	0.7
Dark Interior	9,500	4.1
Framing of Driver	3,772	1.6
Clarity of Driver	19,898	8.5
Framing of Car	15,789	6.7
Data Error	5,202	2.2
Exposure	1,159	0.5
Total Not Issued For Controllable Factors	61,276	26.4
Not Issued Due To Moratorium	960	0.4
CITATIONS ISSUED	83,931	36.0
Hours of Enforcement	204,290	

In Figure 5-2, the overall percent of recorded violations being converted to citations is presented for each of the photo-enforced locations. The percent of citations issued varies from a low level of about 21 percent for the Imperial Avenue/Euclid Street (1484) and Miramar Road/Camino Ruiz (1534) intersections to a high level of about 54 percent at the intersection of Mission Boulevard and Garnet Avenue (1542). More than 50 percent of the violations recorded at the College Avenue/Montezuma Road (1462) and Black Mountain Road/Gemini Avenue (1551) intersections are cited.

Figure 5-1
BREAKDOWN OF CITATIONS NOT ISSUED BY FACTOR

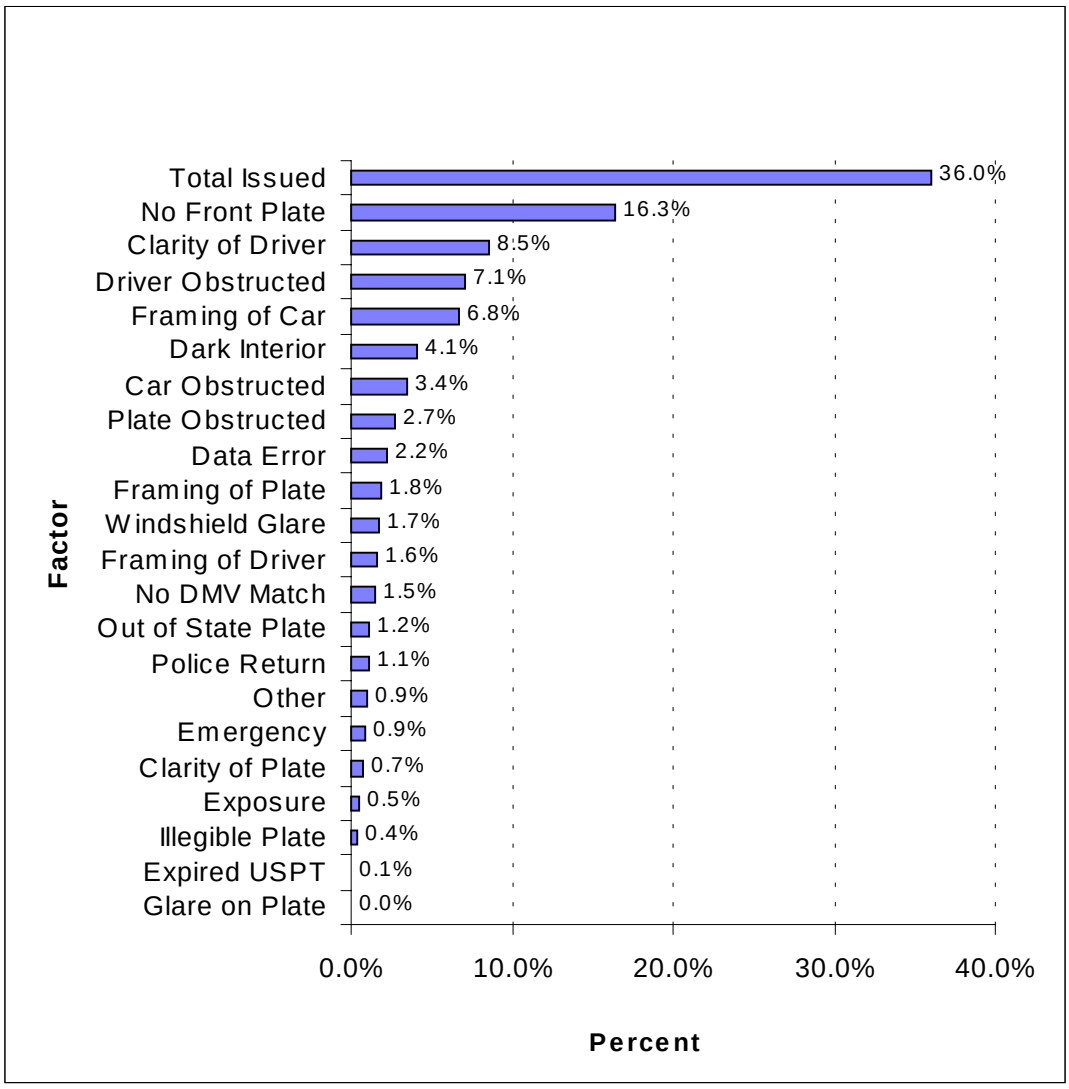

Figure 5-2
PERCENT CITATIONS ISSUED BY INTERSECTION

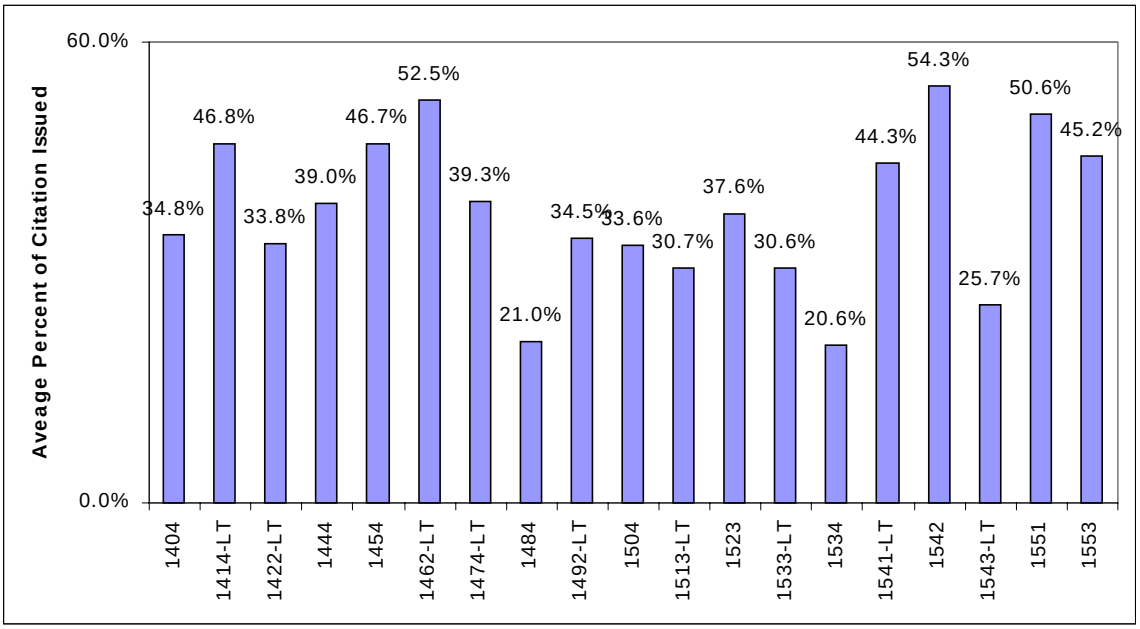

Figure 5-3 shows the same data for the photo-enforced intersections, but with the average monthly number of violations and citations depicted instead of the percentage of violations being cited. From this data, it is easily remarked that intersection of North Harbor Drive and Grape Street (1533) experiences a much higher incidence of red light running violations that any of the other photo enforced intersections. At this intersection, left turn violations are enforced. It may also be noted that there are very low levels of red light running at the Harbor Drive/32nd Street (1444) and F Street/Tenth Street (1504) intersections as well as moderately low levels at the Imperial Avenue/Euclid Avenue (1484), Miramar Road/Camino Ruiz (1484), and Black Mountain Road/Gemini Avenue (1551) intersections. Through red light running violations are monitored at each of these intersections where there are low levels of red light running violations.

5.2 DATA ANALYSIS METHOD

The overall contribution of each factor that prevented violations from being cited can be seen in Figure 5-1. It should be noted that, out of the 21 factors shown, some factors are clearly independent of the performance of intersection equipment. For example, “No Front Plate”, which is the largest factor for the citation failure, is not affected by the camera placement or equipment settings. On the other hand, “Clarity of Driver” may be highly correlated with the lighting conditions and the camera settings. To analyze the photographic results from each intersection, the factors shown in Figure 4-1 have been re-classified into two new groups: Intersection Related Factors and Intersection Independent Factors. Only Intersection Related Factors are used in this analysis. Intersection Related Factors are those factors that appear to influenced by the lighting, filter, shutter speed, and other optical aspects of a camera equipment or those factors affected by the geometric relation between the picture object and camera such as camera location, height, focal length and perspective (angle and framing) of the camera.

Specific features of an individual intersection such as intersection length, alignment, slope, loop placement, and obstacle structures and traffic conditions such as the direction of movement, proportions of heavy or large vehicles, and overall traffic demand can all contribute to the performance of the installed camera system.

Figure 5-3
AVERAGE MONTHLY NUMBER OF VIOLATIONS AND CITATIONS ISSUED BY PHOTO ENFORCED INTERSECTION

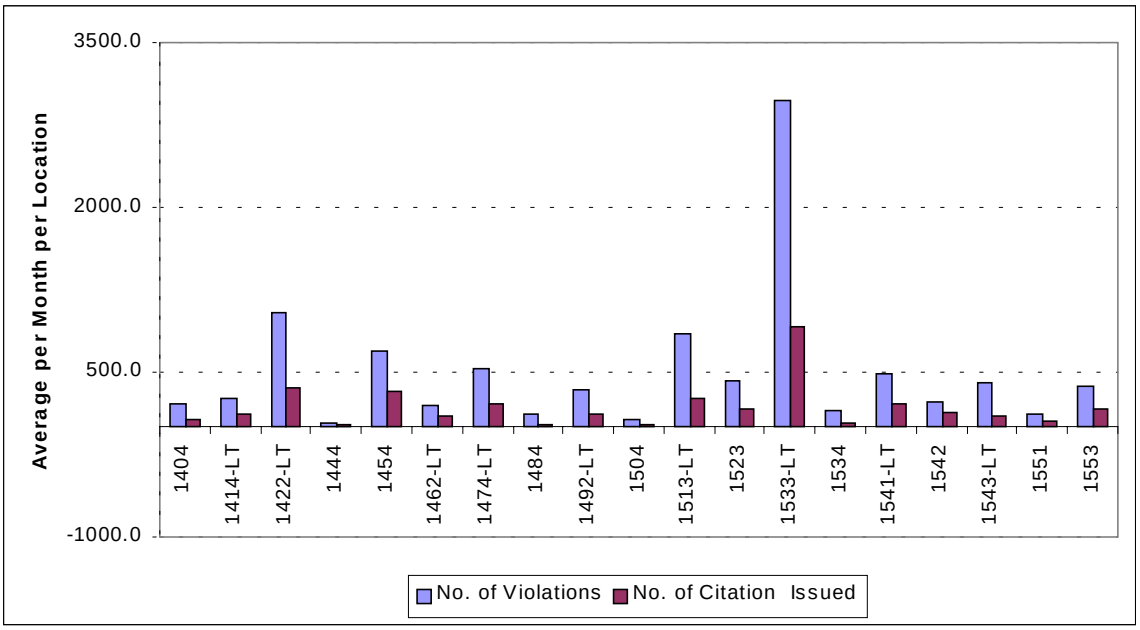

Table 5-2 summarizes the classification of intersection related factors. For the analysis, only factors accounting for more than one percent of the citations not issued were considered.

Table 5-2
RECLASSIFICATION OF INTERSECTION RELATED FACTORS

Category		Factor	Percent Citations Not Issued
Lighting And Optical Factors	Glare	Windshield Glare	1.7
	Clarity	Clarity of Driver	8.5
		Dark Interior	4.1
Geometric Factors	Obstruction	Driver Obstruction	7.1
		Car Obstruction	3.4
		Plate Obstruction	2.7
	Framing	Framing of Car	6.8
		Framing of Plate	1.8
		Framing of Driver	1.6

The re-classified data was tabulated into a set of tables, identical in format to Table 5-1. In total, nineteen tables one for each photo-enforced intersection were created and the results reviewed to check for differences among intersections or groups of intersections.

5.3 ANALYSIS OF LIGHTING/OPTICAL FACTORS

Citations not issued for lighting and optical factors included citations not issued as the result of windshield glare, clarity of the driver's face, and dark vehicle interiors where the driver's face could not be clearly identified.

5.3.1 Windshield Glare

Windshield glare is caused by the sunlight reflecting off the windshield that prevents the camera view from penetrating the interior of a vehicle. Windshield glare is closely related to the time of day and the direction of vehicle movement as well as with the angle between the camera and the sun. Not surprisingly, the analysis of the windshield glare indicates that the percent of citations not used due to windshield glare is highly related to the direction of movement (see Figure 5-2). Of the nine photo-enforced intersections where the percent of citations not issued are greater than 2.0 percent, seven intersections are oriented westbound or eastbound and only two intersections are northbound. It is also noted that four of the intersections with the higher rates of citations not issued for windshield glare do not have cameras equipped with polarizing filters.

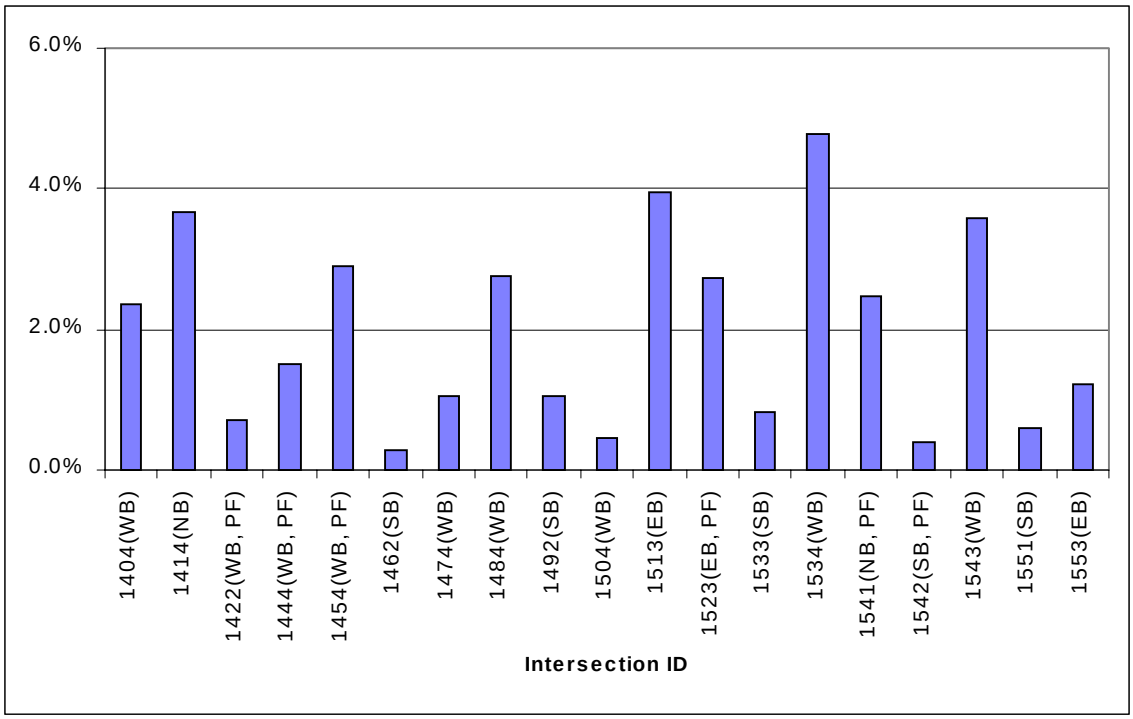

Figure 5-4
CITATIONS NOT ISSUED DUE TO WINDSHIELD GLARE

5.3.2 Clarity of Driver/Dark Vehicle Interiors

The percent of citations not issued due to dark vehicle interiors and poor clarity of driver's face were analyzed. The results for these factors by intersection are highly correlated as shown in Figures 5-3 and 5-4. A total of 4.1 percent of all recorded violations could not cited due to dark vehicle interiors. This problem results from the high degree of contrast between the vehicle interior lighting and the ambient outside lighting under strong daylight conditions. The camera exposure is adjusted automatically for the dominant ambient brightness outside the vehicle and, therefore, the interior of a vehicle tends to be under-exposed. This problem is more pronounced for vans and passenger cars with tinted windows where outside backlighting is blocked from the vehicle interior. Auxiliary flash units may be employed to mitigate the problem and reduce the number of citations not issued for this reason. The installation of auxiliary flash units at the intersections with the highest number of citations being not issued for dark vehicle interiors should be investigated.

The analysis of citations not issued for dark interiors also suggested that the problem could be related to the direction of travel being enforced. Six intersections that show higher percents of citations not issued due to dark interiors are oriented either westbound or eastbound. Cameras at four of these intersections are not equipped with polarizing filters.

The problem of poor clarity of the driver's face was the most common factor for not issuing citations, accounting for 8.5 percent of the total violations. California law requires that the driver's face be clearly visible in one of the photographs, usually the second photograph, in order for a citation to be issued. The direction of travel for the photo-enforced approaches at the intersections with the three highest citations not issued rates for poor clarity of the driver's face are either westbound or eastbound. None of the cameras at these intersections are equipped with polarizing filters.

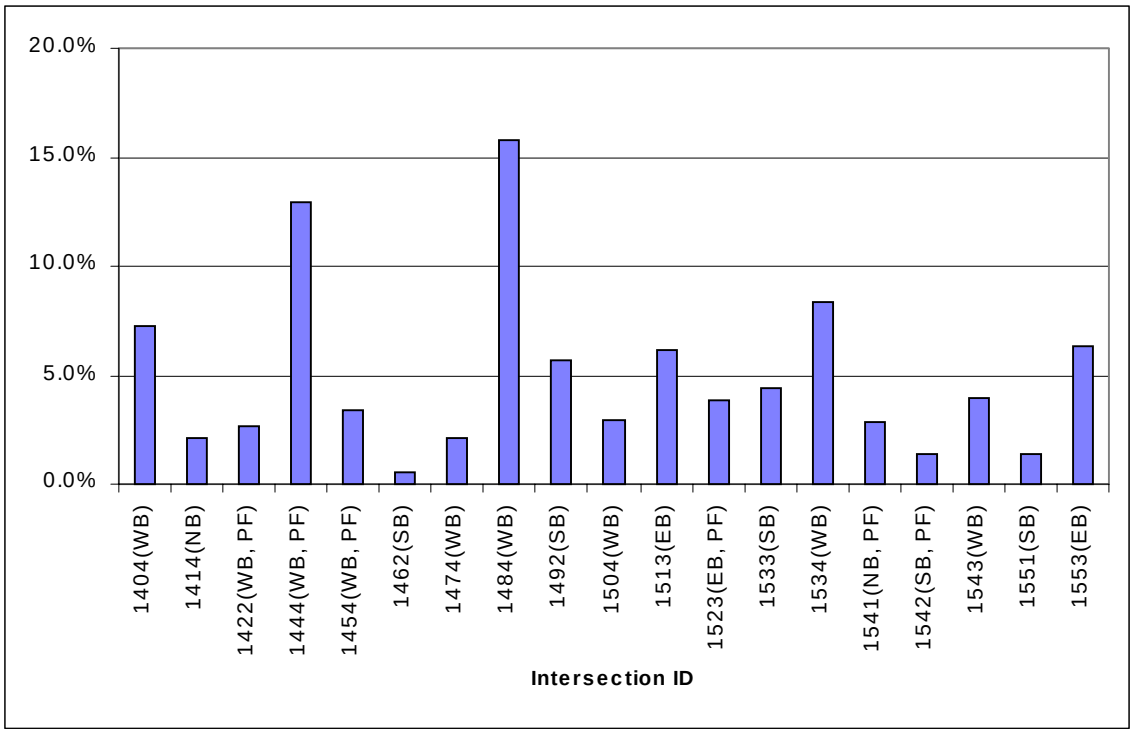

Figure 5-5
CITATIONS NOT ISSUED DUE TO DARK VEHICLE INTERIOR

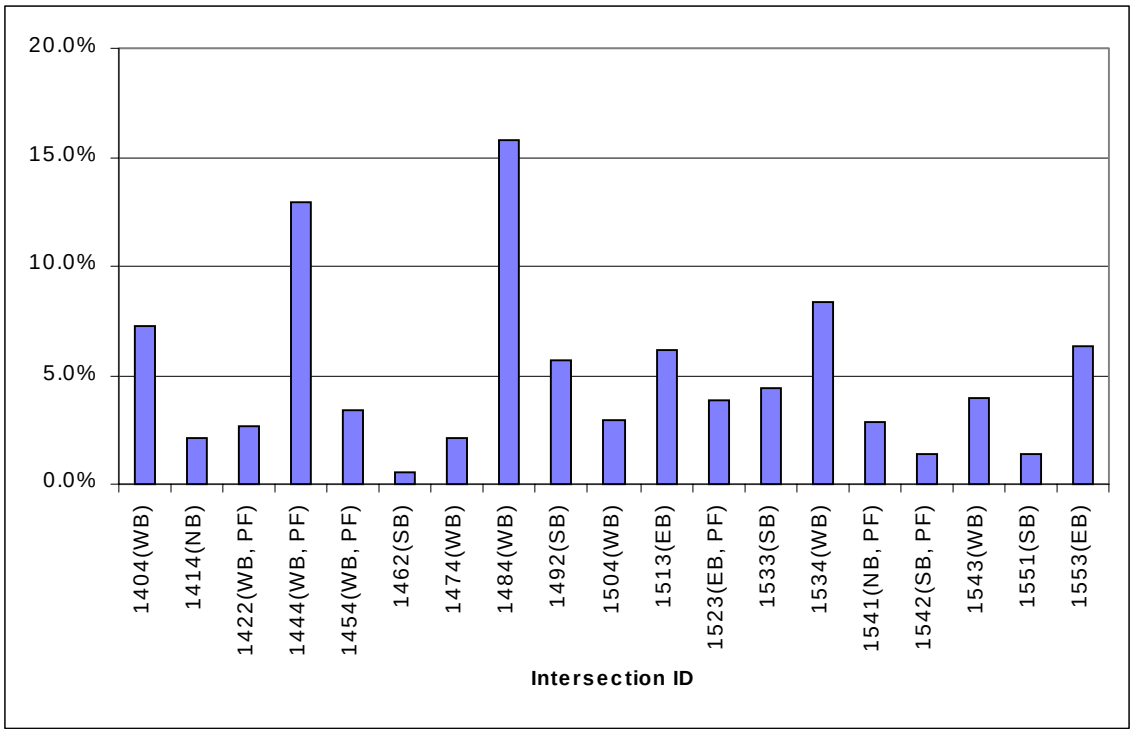

Figure 5-7
CITATIONS NOT ISSUED DUE TO POOR CLARITY OF DRIVER

5.4 ANALYSIS OF GEOMETRIC FACTORS

Problems of obstruction and framing are affected by the geometric relation between the picture object and camera such as camera location, height, focal length and perspective (angle and framing) of the camera. Specific features of an individual intersection such as intersection length, alignment, slope, loop placement, and obstacle structures and traffic conditions such as moving direction, proportions of heavy or large vehicles, and overall traffic demand can all affect the performance of the installed camera system.

5.4.1 Driver Obstruction

Driver obstruction is the second most common reason among the Intersection Dependant Factors that result in citations not being issued. Driver obstruction occurs when the driver's face is blocked by another vehicle, rear view mirror, sun visor, or vehicle roof. Figure 5-5 shows the percent of citations not issued due to obstructed views of the driver for each of the photo-enforced intersections. Intersections 1404 and 1504 show the highest percent values. The crossing streets of both of these intersections are narrow. The distances between the camera and violating vehicle at these intersections are relatively short and the vertical camera angle to the driver's face is steeper than those of other intersections with broader crossing streets.

It is possible that using a lower camera pole or relocating it further downstream from the intersection might provide an improvement for these intersections.

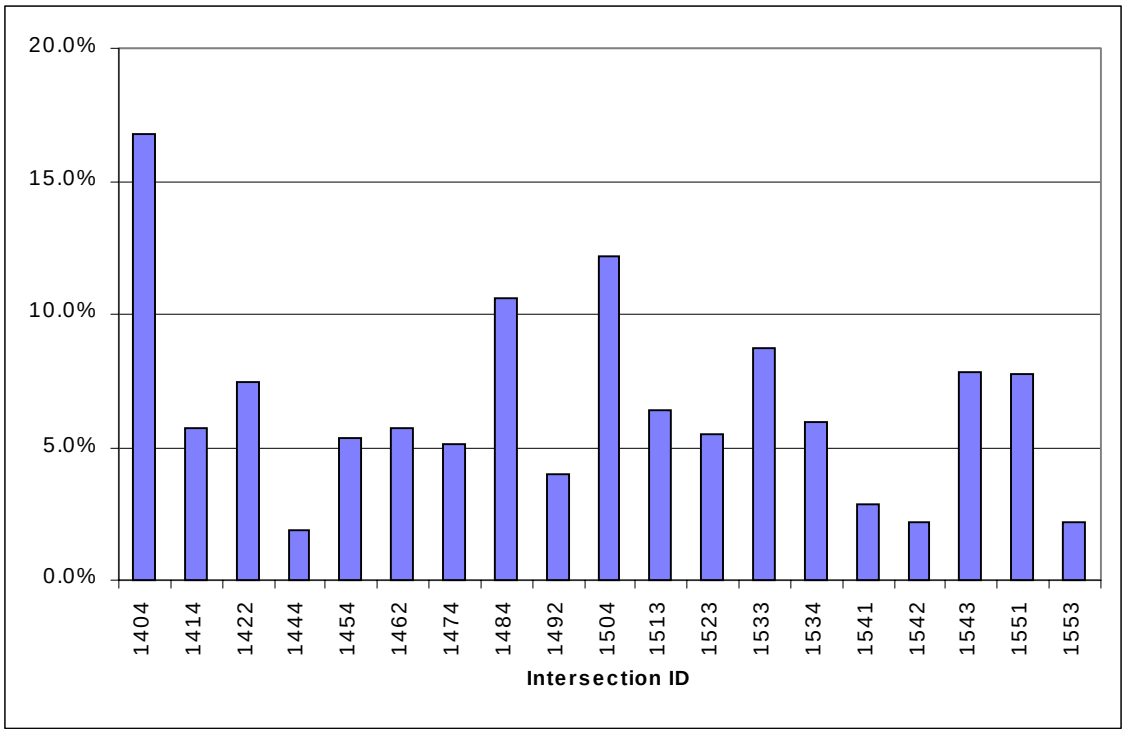

Figure 5-8
CITATIONS NOT ISSUED DUE TO DRIVER OBSTRUCTED

5.4.2 Vehicle And License Plate Obstruction

When the view of the license plate or vehicle is blocked by another vehicle further ahead in the intersection, it may not possible to issue a citation. Obstructed views of the vehicle and plate occur more frequently at locations where left-turn movements are being enforced. Figure 5-7 shows that the intersections where the highest percent of citations not issued due to obstructed views of the vehicle or license plate are 1474, 1492, 1513, 1533, and 1543, all locations where left-turn enforcement is being done.

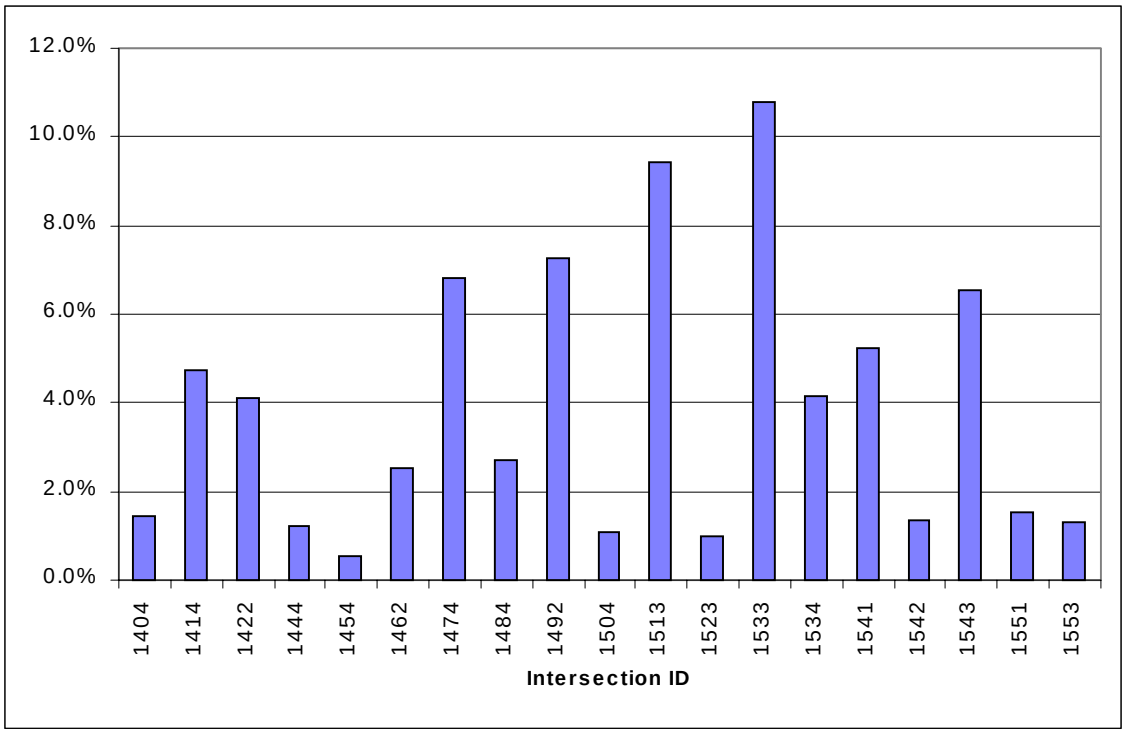

Figure 5-9
CITATIONS NOT ISSUED DUE TO LICENSE PLATE AND VEHICLE OBSTRUCTION

5.5 ANALYSIS OF FRAMING FACTORS

The license plate, vehicle, or driver's face is outside of the frame of the second photograph. Poor framing may be caused by a camera lens with a focal length that is too long, poor camera angle alignment, or intersection geometric factors that result in motorists speeding up, making irregular turning movements, or being close to the camera when the second photograph is taken. Figure 5-7 shows the variations in the citations not issued for framing reasons by intersection.

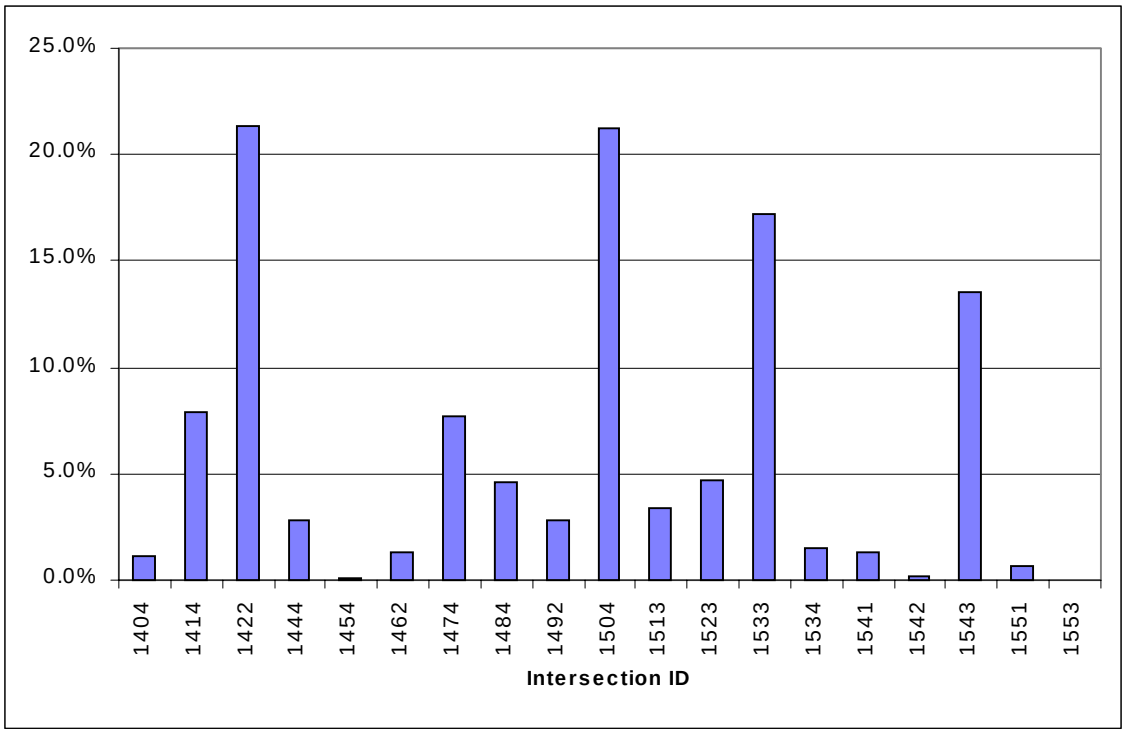

Figure 5-10
CITATIONS NOT ISSUED DUE TO FRAMING

Intersections 1422, 1533, and 1543 have experienced higher rates of citations not being issued due to framing problems. Enforcement at each of these intersections is for double left-turn lanes. For these locations, factors contributing to the higher rates of citations not issued are motorists speeding up as left turn movements are being completed (especially if being done against as red traffic signal), irregular turning movements, and a relatively shorter distance from the camera to the point where the second photograph is taken. Figure 5-8 summarizes the citations not issued data combined for obstruction and framing factors for this type of left turn lane enforcement, showing higher rates of citations not issued for left turns and left turns combined with through traffic enforcement.

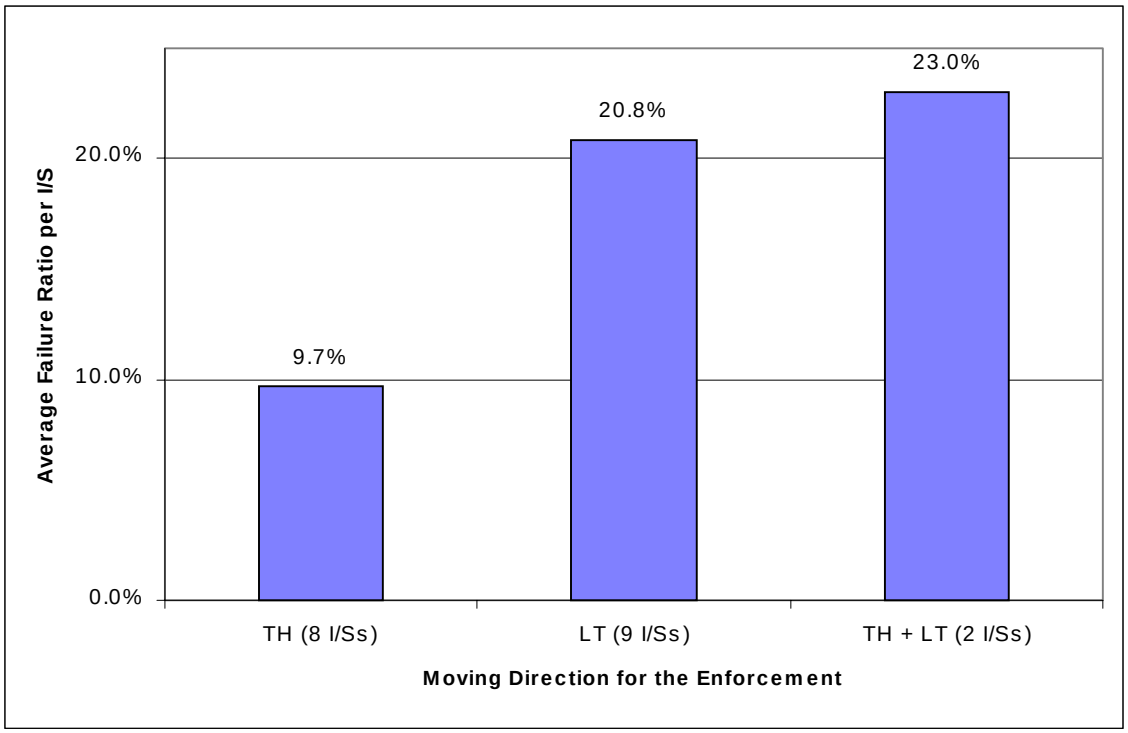

Figure 5-11
CITATIONS NOT ISSUED FOR OBSTRUCTION AND FRAMING FACTORS BY TYPE OF ENFORCEMENT

5.6 FINDINGS AND RECOMMENDATIONS FROM REVIEW OF PHOTOGRAPHIC DATA

- A total of 83,931 citations have been issued to motorists under the City's photo enforcement program. About one quarter of the citations have been issued for violations at one intersection, at North Harbor Drive and Grape Street, where the photo enforcement cameras monitor left turn movements.

  Citations are issued for approximately 36 percent of the possible violations recorded at the photo-enforced intersections. Accounting for the number of possible violations that are discarded after the grace period time allowances are applied, the percentage of recorded violations that are converted to citations is increased to 43 percent.

  The percent of citations issued varies from a low level of about 21 percent for the Imperial Avenue/Euclid Street (1484) and Miramar Road/Camino Ruiz (1534) intersections to a high level of about 54 percent at the intersection of Mission Boulevard and Garnet Avenue (1542). More than 50 percent of the violations recorded at the College Avenue/Montezuma Road (1462) and Black Mountain Road/Gemini Avenue (1551) intersections are cited.

- The largest number of citations not issued, amounting to 16.3 percent of the possible violations, is for no front license plate. This percentage is consistent with the levels reported by other photo enforcement programs. A portion of these violations could be cited with the installation of nearside cameras that are able to photograph the rear

license plates of red light runners. With nearside cameras at each photo-enforced intersection, the number of issued citations each month would increase by approximately seven percent.

- Approximately 14 percent of the possible violations are discarded due to lighting and optical problems where the driver's face is not clearly visible in the second photograph as required by the California Vehicle Code. Auxiliary flash units could be installed to provide additional vehicle interior lighting at photo-enforced intersections where dark vehicle interiors are a recurring problem. It is also possible that polarizing filters could be employed at additional locations, especially for intersection approaches that are oriented east and west, to increase the number of citations issued.

  Approximately 23 percent of the possible violations are not cited because the driver's face, vehicle, or license plate is out of the frame of the photograph or is obstructed. These factors are more common at intersections where double left turn lane movements are being enforced.

  The City and its contractor, LM/ACS, should address these various problems at the photo-enforced intersections, one at a time, using photographic data to analyze the nature of problems, to develop improvement strategies, and to evaluate whether the improvements have been effective.

- The City should review the other photo enforcement systems that are currently being deployed in California and other States. New photo enforcement technologies have become available over the past five years, most notably technologies that employ digital camera equipment where photographic data, including streamed video clips, may be immediately downloaded for processing using T-1 telephone line or microwave communications. Additionally, photo enforcement systems that use non-intrusive vehicle detection methods as well as systems that employ overhead camera placements and floodlighting equipment as an alternative to the curb-based placements used for the San Diego program are being tested by cities throughout California and elsewhere.